5099

Taxonomy, Distribution and Biology of the American Golden Plover, *Pluvialis dominica* and the Pacific Golden Plover, *Pluvialis fulva*

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Introduction

Along the Beaufort coast of Alaska, the American Golden Plover, Pluvialis dominica, nests on tundra and forages only occasionally on beaches, mudflats and in saltmarshes. It is therefore less directly exposed to the potential effects of a coastal oil spill than are several related species of shorebirds. Its seasonal habitat use pattern represents something of an extreme when viewed on a tundra to shoreline continuum, with the frequently swimming phalaropes at one end, and most other wading shorebirds in between. This difference in habitat dependency makes the plover sensitive to different development effects. This species account is written partly to define the life cycle and habitat associations of a tundra-oriented shorebird.

Golden Plovers are of further interest because of regional differences in habitat use, and because confusion exists in previously published literature regarding the taxonomy and distribution of two subspecies. This report analyzes these problems, introducing new evidence and concluding that there are two separate species of golden plovers involved, which may account for an observed difference in use of littoral habitats between the Beaufort Coast and the Southern Chukchi coast .

Taxonomy

Most authors over the past several decades have considered the American (or Lesser) Golden Plover to consist of two subspecies, or races, Pluvialis dominica dominica and P. d. fulva. The former race is common in arctic Canada and on Alaska's North Slope; P. d. fulva nests in Siberia. Both races, as well as individuals difficult to identify to either race, have been collected at several sites in Northwestern Alaska. These intermediates were usually presumed to be hybrids. The assumption in this designation as subspecies is, of course, that the two forms interbreed where they occur together. As a result of a multi-variate statistical analysis of size measurements and plumage differences, I have concluded that the two forms should be regarded as separate full species (Connors, in prep.). The basis for this conclusion is the lack of evidence of increased numbers of intermediate birds in areas where both forms nest. These would be expected if interbreeding were common. Field evidence bearing on this question is needed, but the conclusion is appropriate based on present information; in this report I will refer to two species: Pluvialis dominica, the American Golden Plover, and P. fulva, the Pacific Golden Plover.

Description

In breeding plumage the two species are difficult or impossible to distinguish in the field. Both forms are striking in appearance, with black face, breast and abdomen

outlined by a white band on the forehead and sides of the neck, and topped with an irregular pattern of gold, white and black spotting on top of the head and back. The bill and legs are black. Golden Plovers are medium-sized (23 cm high; 160 gin), slender, graceful shorebirds with relatively short bills and moderately long legs.

The Pacific Golden Plover is often described as being somewhat more golden in breeding plumage, but specimens show a wide range of overlap in this characteristic. Males in full breeding dress differ more consistently in color of undertail coverts: those of dominica are predominantly black compared to the mostly white feathers of fulva. This distinction does not hold for females, Males also differ slightly in the width of the black and white forehead bands (marginally wider in dominica) but this character also overlaps broadly. Size characteristics separate the species more consistently. Dominica have larger wings, but slightly shorter tarsi (leg bones) and bills (Table 1). Relative proportions thus differ even more than single measurements. Sexes are surprisingly similar in size in both species, but females average 21 gms heavier in June at Barrow ($p < .001$, $n=26$; unpublished data of F. A. Pitelka). This difference diminishes in July as weights of both sexes increase.

Juveniles and adults in winter assume a less ostentatious plumage, more uniform in color, spotted on the back and lightly spotted or barred on the breast. P. dominica becomes greyish-brown and rather drab in winter; P. fulva is lighter and more golden-tan. This difference in coloration is most pronounced in juveniles prior to southward migration in August, at which time an experienced field observer can identify most juveniles to the appropriate species.

Distribution and Abundance

The American Golden Plover breeds across northern Canada from Devon Island, Baffin Island and the western shore of Hudson Bay to northern and northwestern Alaska. From the evidence of museum specimens, it is more common than P. fulva at Barrow and along the Chukchi shore to at least Cape Krusenstern near Kotzebue Sound. It nests less commonly at Wales, Nome and along the Yukon-Kuskokwim Delta to Nunivak Island. It probably nests occasionally in Northwestern Siberia as well. P. dominica numbers were greatly reduced by hunting during the 1800's but have recovered and may still be increasing (see Management, below).

The Pacific Golden Plover breeds from the Yamal Peninsula on the arctic coast of Siberia east into Alaska, where it is the more common golden plover from Nunivak Island north to Wales; it also nests near Kotzebue and occasionally as far north and east as Barrow. Table 2 lists the proportion of museum specimens assigned to each species at several localities in northwest Alaska.

Table 1. Golden Plover specimen measurements: (mean ± standard deviation). From Connors (in prep.).

		n	Wing	Tarsus	Bill
P. dominica (Canada and north-east Alaska)	males	42	177.6±4.3	43.9±1.2	22.7±1.1
	females	35	176.8±3.9	43.6±1.8	22.6±1.1
P. fulva (Siberia and Asia)	males	44	165.1±4.2	44.3±1.5	23.6±1.0
	females	16	165.5±5.5	44.5±1.5	23.5±1.5
dominica vs fulva, sexes combined			$p < .0001$	$p < .03$	$p < .0001$

Table 2. Relative abundance of golden plover specimens collected in northwest Alaska, 1877–1980. See Figure 1.

	REGION			
	1	2	3	4
P. fulva	8.0%	19.2%	83.9%	73.5%
P. dominica	92.0%	80.8%	16.1%	26. 5%
n	100	26	62	38

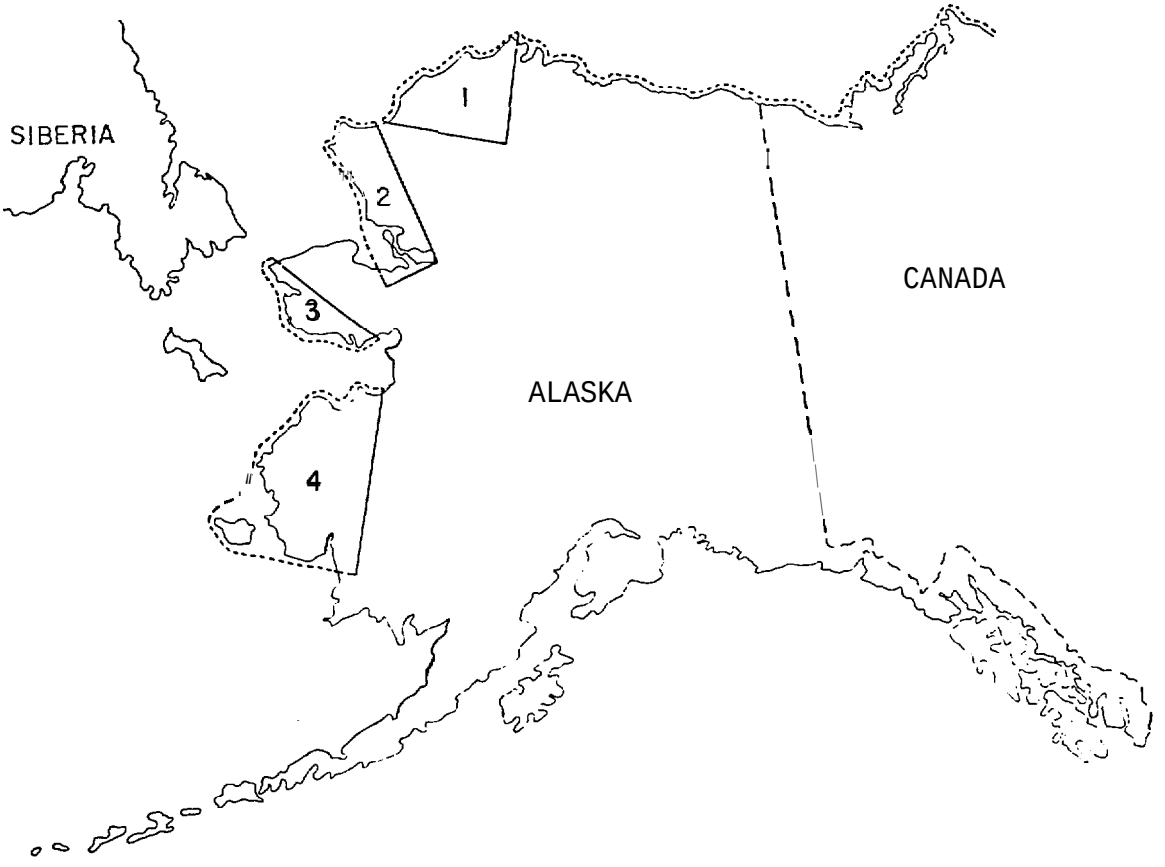

Figure 2. Location of museum specimen regions listed in Table 2. Boundaries indicate collection localities, not plover ranges.

Although the species overlap considerably in breeding range, winter ranges are quite distinct. P. dominica migrates primarily along the Atlantic coast and interior of North America, wintering in Bolivia, Paraguay, Brazil, Argentina and Uruguay. P. fulva migrates along the Bering Sea coasts and over the Pacific Ocean to winter in southern Asia, Hawaii, New Zealand, Australia, and on many island groups in the western and central Pacific Ocean. This distinct difference in winter ranges and migration routes may have been an important factor in maintaining reproductive isolation between the species (Connors, in prep.).

Nesting densities have been measured at several arctic coastal sites, and qualitative density estimates have been reported for other areas. Table 3 lists a compilation of these densities. Although this is insufficient information to give reliable estimates of total population size, we can use it to address a question of the sources of juvenile P. fulva observed in early migration along the north shore of Seward Peninsula in August 1977 and 1978. A small number of census transects, walked at sites crossing the barrier strip of dunes, saltmarsh and low tundra east and west of Shishmaref, produced estimates of 77 birds/km^2 and a total of 13,800 birds along the 160 km of barrier strip. (Connors and Risebrough, 1979). More frequent censuses might have measured a higher peak during migration movements. These juvenile plovers were almost all P. fulva, indicated by their bright golden coloration. Can this many juvenile fulva have been produced by North American fulva nesting north of Seward Peninsula, whose offspring have just begun their southward migration?

From Table 3 we can make this very rough summary of breeding densities: In coastal lowlands with ridges, densities are fairly high, in the range of 3 to 8 pairs/km^2; this habitat is limited, however. Plovers are absent from low wetlands or shrub areas. Over the few inland sites studied densities approximate 1 pair/km^2, except at the Franklin Bluffs study site, where densities are very high along the sloping tundra bordering the Sagavanirktok River. Comparable habitats may border all rivers, but do not represent the entire North Slope. Furthermore, some extensive areas may be unsuitable for nesting (too sparsely or too thickly vegetated, too wet, too steep).

To obtain a rough estimate of the fulva population from Seward Peninsula to Barrow we will use 0.5 to 1.0 pairs/km^2 as a range of mean density of both species combined over all areas, and will apply frequency information from museum specimens listed in Table 2. The frequency and therefore density of fulva varies from north to south, but our estimate of total fulva nesting in Alaska north of Shismaref on Seward Peninsula is 9,300-18,600 pairs.

Table 3. Nesting densities of golden plovers in Alaska

Location	Coastal/ Inland	Total Plot Size, ha	Years Censused	Average Density (Prs/km^2)
Okpilak River Delta[1]	c	175	1	1.3
Canning River Delta[2]	c	77	2	2.6
Prudhoe Bay[3]	c	70	2	0.0
Prudhoe Bay[4]	c	100	3	.8-1.5
Franklin Bluffs[5]	I	100	3	5-10
Barrow[6]	c	94	2-5	7.7
Atkasook[6]	I	25	3	1.3
Kaolak River[7]	I	1000	1	0.9
Pitmegea River[8]		27	1	1.9
Cape Thompson9	C/I	3380	1-2	1.0
Cape Krusenstern[10]	c	30	2	3.4
Cape Espenberg[11]	c	50	2	1.0
Kitluck River[12]	c	35	1	0.0
Arctic River[12]	c	55	1	0.0
Wales[13]	c	25	1	0.0
Seward Peninsula[14]	I	--	--	1-2
Akulik-Inglutalik River Delta[15]	c	110	1	0.0

References listed on following page.

Table 3. References

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[1]Spindler (1978)

[2]Martin and Moiteret (1981)

[3]Norton et al. (1975)

[4]Hohenberger et al. (1980, 1981, 1982). Listed densities have been approximately corrected for a systematic overestimate in the published densities.

[5]Jones et al. (1980); Garrett et al. (1981); McCaffery et al. (1982). Listed densities have been approximately corrected for a systematic overestimate in the published densities.

[6]Myers and Pitelka (1980)

[7]Maher (1959)

[8]Childs (1969)

[9]Williamson et al. (1966)

[10]Connors and Connors (1978); Connors et al. (1979a)

[11]Schamel et al. (1979)

[12]Golden plovers present in area; more common in uplands. Wright (1979)

[13]Golden plovers nesting on nearby slopes. Hirsch and Woodby (1978)

[14]Densities are rough estimates, based on single visit surveys over a wide area. Brina Kessel, pers. comm.

[15]Shields and Peyton (1979).

Based on survival rates for other small and medium-sized shorebirds, (Boyd 1962; Myers and Connors, unpublished data), it is reasonable to expect adult annual survival rates of 75% or above and juvenile survival, from fledging and early migration, of about 50%. As a simple model, this requires that each pair produce 1 migrating juvenile per year to maintain a stable population. The 9,300 to 18,600 pairs of fulva could therefore produce the observed 13,800 juveniles. However, juveniles are also fairly common in late August at other coastal sites around Kotzebue Sound, so the total juvenile population may be considerably higher.

Two other sources exist for the Seward Peninsula fulva juveniles. Birds fledged south of Shishmaref may first move north, subsequently retracing their flight and continuing south to winter quarters. This seems plausible for birds fledged on the northern half of Seward Peninsula, but much less plausible for birds farther south, where fulva are most common in Alaska. Alternatively, birds fledged in Northeastern Siberia may begin their migration traveling southeast, crossing Bering Strait to forage in the saltmarshes of Seward Peninsula. After increasing their fat reserves, they could resume their migration, traveling south and southwestward to winter areas. Such a route would suggest that the Seward Peninsula saltmarshes are even more of an international ornithological resource, with Siberian birds possibly depending upon conditions there for successful migration.

This surprising, indirect migration route is given some support by observations of another shorebird. Sharp-tailed Sandpipers (Calidris acuminata) nest only in Siberia and winter in the southern Pacific (New Guinea, Australia) , but juveniles are fairly common in the same saltmarshes of northern Seward Peninsula in early September. Numbers are much lower than for P. fulva, so this doesn't represent a major migration pathway for Sharp-tailed Sandpipers, but neither is it an unusual occurrence of out-of-range stragglers.

The densities listed in Table 3 can also be used to estimate the total breeding populations of golden plovers in Alaska, although the assumptions necessary introduce a wide range of possible error. This is especially true of inland areas, of which the breeding range is poorly known, large areas may be unsuitable as nesting habitat, and we have very few measured densities. In spite of these limitations, the exercise is instructive. Using as an average density the range of 0.5 to 1.0 pairs per km^2 and breeding ranges mainly north of 67° N latitude excluding high elevations in the Brooks Range (P. dominica) and mainly west of 158° W longitude excluding lowland areas of the Yukon-Kuskokwim Delta (P. fulva), we calculate a dominica population of 140,000 to 280,000 pairs, and a fulva population of 75,000 to 150,000 pairs. These figures must not be taken too seriously; however they suggest a total Alaskan combined population of

a few hundred thousand to more than a million birds.

Nesting

In this section both species will be treated together, since in areas of overlap most observers have not distinguished between them, and because with few exceptions we lack detailed comparative data for the two forms.

Golden Plovers nest on well-drained sites on upland tundra or on the higher, drier sites (ridges and high polygons) in lowland tundra. Nest sites are usually sparsely vegetated, with mosses, lichens and scattered grasses, sedges and forbs providing very little cover. Eggs are laid in a shallow scrape frequently lined with bits of lichen or moss. The most frequent clutch size is 4, but 3 egg clutches occur occasionally. Eggs are cryptically colored with dark brown or black spots on a buff background.

Sauer (1962) has reported that some fulva arrive to breed on St. Lawrence Island already paired, but J.P. Myers and F.A. Pitelka believe pairing occurs after birds arrive at Barrow (pers. comm.). Males display in a "butterfly" flight over territories at elevations up to 100 m and both sexes perform a variety of pairing, aggression, and distraction displays on the ground (Drury, 1961).

Territory sizes vary, probably depending on habitat type and local plover densities, and possibly unavailability of food resources at a site; but golden plovers defend large territories compared to most sandpipers, usually including 5 to 20 ha of tundra.

Degree of annual variation in nesting densities of golden plovers at Barrow is about average compared to other common shorebirds at that site. Myers and Pitelka (1980) report a coefficient of annual variation of 62% on each of two study plots censused for 5 consecutive years. This is less than the variation exhibited by Pectoral Sandpiper and Red Phalarope, is comparable to Baird's Sandpiper, and is greater than Dunlin and Semipalmated Sandpiper.

Nest dates vary with latitude, elevation, and weather, depending on snow melt in some areas. Clutches may be completed by late May in southern areas but mid-June is more normal over most of the range in Alaska. Incubation, by both sexes, lasts about 27 days.

Productivity also varies widely. In two studies with sufficient sample sizes, nest success (per cent of nests observed which produced young out of the nest) ranged from 8% to 89%, principally as a result of different predation rates (Table 4).

Young plovers leave the nest when about one day old and are tended by one or both adults until they are about able to fly. Adults begin migration soon after their nesting

Table 4. Golden plover nest success at two Alaskan sites.

	Year	Nests Observed	Number Successful	Success Rate	Young Per Nest
Franklin Bluffs,[1] 69 km South of Prudhoe Bay	1979	13	5	38%	--
	1980	12	5	42%	--
	1981	12	1	8%	--
Cape Thompson[2] and Ogotoruk Valley	1960	9	8	89%	3.2
	1961	35	25	71%	2.8

[1] Jones et al. (1980); Garrett et al. (1981); McCaffery et al. (1982).

[2] Williamson et al. (1966). These dates have not been corrected for different durations of observations. Applying a correction such as suggested by Mayfield (1961) would reduce success rates an unknown amount.

duties are complete; juveniles remain in the arctic for several weeks longer, departing in August or early September.

Habitat Use and Foraging Ecology

As noted earlier, golden plovers nesting on the North Slope are primarily birds of the tundra, with limited use of shoreline habitats along the Beaufort coast. Tundra habitat studies by Myers and Pitelka (1980) characterized golden plovers at Barrow and Atkasook as birds of the drier, more upland sites at both locations. This preference persisted during breeding and post-breeding periods, although the degree of preference differed among years, probably in response to inter-year differences in plover nesting densities.

Golden plovers at Barrow do not show the marked shift exhibited by most shorebirds to much heavier use of shoreline habitats in late summer (Connors et al. 1979b). Some plovers occur on beaches, mudflats, and in saltmarshes, but densities in these habitats along the Beaufort coast remain low (Table 5). Cumulative densities on littoral zone transects at Barrow amounted to only 13% of the use afforded tundra transects. Farther south, however, along the Chukchi and Bering Sea coasts, golden plover habitat use patterns differ considerably. At Cape Krusenstern and Wales in 1977, these birds were common in both tundra and littoral habitats (Table 5). Cumulative densities on littoral zone transects were approximately 5 times higher than at Barrow, and equalled 72% of tundra use. Tundra densities were similar in both areas. Along the north shore of Seward Peninsula, as noted above, densities in August-September were even higher in saltmarsh habitats. Considering our contention that these juveniles are mostly P. fulva, a bird we consider specifically distinct from the P. dominica of the Beaufort coast, might this represent a real habitat difference between the two species? We can not be certain, because the choice of habitat at any site must reflect the availability of habitats and of resources represented by those habitats. The extensive saltmarshes of the southern Chukchi might also prove attractive to juvenile P. dominica, but these birds are less common in that region. Likewise P. fulva might be more restricted to tundra habitats if this species were common along the Beaufort coast. Unraveling this complicated question will require comparative habitat studies of both species in regions where they are sympatric.

No definitive diet studies of either golden plover species have been published, but scattered reports of stomach samples indicate that golden plovers in Alaska take a variety of insects (adults and larvae), spiders, and in Spring and late Summer, berries of Empetrum nigrum (crowberry, blackberry) and Vaccinium (blueberries).

Table 5. Tundra and littoral habitat use by golden plovers

	Cumulative density[1]		Relative use of littoral habitats
	Tundra	Littoral	
Barrow	2.47 birds/ha[2]	.31 birds/ha[3]	13%
Southern Chukchi sites	2.25 birds/ha[4]	1.63 birds/ha[4]	72%

[1] transect densities summed over 20–5 day census periods, 5 June-12 September.

[2] mean densities, 1975-1979, from Myers and Pitelka (1980).

[3] mean densities, 1975-1978, from Connors et al. (1982).

[4] mean of 1977 densities at Wales and Cape Krusenstern study sites, from Connors and Risebrough (1978).

Management

During the past 150 years, American Golden Plover populations have varied widely. In the early 1800's, they may have been more numerous than at present, but their good flavor, abundance, and migratory flocking made them desired prey of sport and market gunners during that century. Audubon (1840) describes a spring hunt near New Orleans in 1821 in which 200 gunners shot an estimated 48,000 plovers in one day. (A century later, Oberholser (1938) described golden plovers in Louisiana as rare transient visitors). They were also taken in large numbers elsewhere in the Mississippi Valley during spring migration and shipped to markets in the east. During fall migration they were hunted enthusiastically along the New England coast. Bent (1929) estimates that the species population reached its low point about 1900, when large flights were no longer seen and the bird was absent from many areas of its former migration range. At this time it was considered by some observers to be heading for extinction along with the Eskimo Curlew and Passenger Pigeon. Changes in game laws from 1900 to 1926 occurred in time, however, and American Golden Plovers have proved capable of a strong increase in population after reduction of that artificially high mortality rate. Today this species is widespread and common in suitable habitat throughout the North American arctic.

Because of differences in migration routes, the heavy shooting had much more effect on populations of *dominica* than of *fulva*. As a result, the populations of this species in Northwest Alaska, as elsewhere, would have been greatly reduced, while the *fulva* occurring in that area might have been relatively unaffected. We would have learned a great deal about population interactions of the species, and their dependence on shared resources, if we had density estimates before and after the decimation. All we can glean from the available data in the form of museum specimens is that the proportion of *P. dominica* compared to *P. fulva* is higher since 1930 than it was in the preceding half century (Table 6; $p < .03$, one-tailed X^2 test). This is to be expected for *P. dominica* recovering from a depressed population level. No marked range changes are indicated however; both species were collected over the same range of sympatry during both periods.

Because Golden Plovers do not often wade in littoral waters, the threat of direct effects of oil spills is less for this species than for several other shorebirds. However, spilled oil washing into the Southern Chukchi saltmarshes where Pacific Golden Plover juveniles forage might alter the vegetation and invertebrate prey populations in that habitat. The loss of these important foraging areas might reduce the energy reserves of thousands of plovers about to migrate to Pacific wintering areas. Other habitat effects of onshore

Table 6. Change in proportion of *P. dominica*: *P. fulva* in museum specimens collected in northwest Alaska

	1877 - 1930	1931 - 1980
Nunivak Island to Wales	20% : 80%	40% : 60%
	n=81	n=15
Kotzebue to Barrow	85% : 15%	91% : 9%
	n=52	n=69

development would affect some plovers, but on the tundra where they nest these birds are seldom concentrated. Dispersion offers a protection against local environmental effects. Because of this difference in habitat use, the sensitivity to coastal oil development is probably greater for P. fulva than it is for P. dominica, but for both species the threat from large oil spills is less than it is for some other shorebird species such as the phalaropes. Golden plovers survived one major threat during the past century, and will probably survive the present one.

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